CONSTRUCTION OF AN RF EMI SHIELDED ENCLOSURE

The attached is a detailed Statement of Work (SOW) for the RF EMI Shielded enclosure referenced in the Naval Research Laboratory's (NRL) Synopsis/Solicitation Number N00173-01-R-JR04, as advertised in the Commerce Business Daily (CBD).

THIS INTERNET ACCESS IS FOR THE DOWNLOADING OF THE SOW **ONLY**.

Interested parties should download the SOW for use in conjunction with the Synopsis/Solicitation Number N00173-01-R-JR04, in preparation of proposals for submission. To access the synopsis/solicitation, vendors should review the NRL CBD announcement entitled, "CONSTRUCTION OF AN RF EMI SHIELDED ENCLOSURE", dated 06 April 2001, Class Code E.

STATEMENT OF WORK
CONSTRUCTION OF AN RF EMI SHIELDED ENCLOSURE

1 INTRODUCTION

This specification establishes the design, construction, and quality assurance requirements of a turnkey shielded enclosure. The shielded enclosure consists of one 12w' x 24d' x 8'h (nominal) metal-walled structure, along with all the necessary ancillary equipment for a complete, functional Radio Frequency (RF) spacecraft electronics test facility.

2 BACKGROUND

Over the past fifteen years, enhancements to achieve electronic system performance and sensitivity specifications have resulted in several long-term program requirements for verification of critical system parameters using calibrated measurement equipment operated in an Electro-Magnetic Interference (EMI) shielded enclosure. The enclosure presently used for this purpose is located on the third floor of building 209. In this facility, NRL engineers make measurements that provide validated assessment of the frequency source phase noise, Allan variance, and receiver sensitivity of space and terrestrial military electronics developed at the Naval Research Laboratory (NRL).

To comply with the NRL management's relocation plan for planned demolition of old buildings, the existing RF lab facility in building 209 is being relocated to a renovated laboratory space in building 65 that will incorporate a newly constructed shielded enclosure. This SOW describes the construction of the new shielded enclosure that will serve as a replacement for the existing test facility. The replacement enclosure shall satisfy the established requirements for attenuation of EMI levels needed to sustain continuity of program test activity and must become operational by early Summer of 2001 in order to avoid critical project schedule impact.

3 SCOPE

The contractor shall be responsible for the design, construction, assembly, installation, performance testing, documentation, materials, and labor for a complete, functional shielded enclosure. The enclosure shall be free standing with no attachments to the parent building except as authorized for electrical/HVAC building services. The shielded enclosure shall be subject to typical EMI testing use including varying and movable floor loads, repetitious use of the access door, and continuous duty cycle of all ancillary equipment.

The shielded enclosure shall include the following, as a minimum:

- Modular galvanized steel laminate panel shielded enclosure with framing system for floor, wall, and ceilings
- Vinyl Floor Tile with Static Dissipative Properties – Forbo ColoRex Brand: Part No. AS3201 or suitable equivalent approved by procurement originator
- Underlayment, Dielectric Vapor Barrier, Conductive Primer, Copper Grounding Strips, and Conductive Tile Adhesive
- One each 4’ x 7’ clear opening Manual Knife Edge Door
- One each 3’ x 7’ clear opening Manual Knife Edge Door
- Eight each 12” x 12” honeycomb waveguide air vents, with dielectric collar and transition adapter (6” flex) to existing HVAC ducting
- Installation of a Pneumatic Thermostat (Thermostat is GFE)
- One each 24” x 24” bulkhead connector panel with removable center panel.
- Electrical Package – 100 amp, 120/208V, 4 wire service, power panel with circuit breakers; 20 amp 120V duplex receptacles; Powerline Filters are GFE – to be removed from the existing shielded enclosure in building 209 for reuse in the new enclosure.
- Lighting – 18 each 180 watt incandescent light fixtures
- One each threaded brass ground stud
- Copper ground bus bar with ground stud on three sides of the enclosure
- RF Shielding Effectiveness Testing

4 APPLICABLE DOCUMENTS

The following documents, of the issue in effect on the date of contract award, form a part of this specification.

4.1 Military Standards

MIL-STD-130C	Identification, Marking of U.S. Military Property
MIL-STD-202A	Test Methods for Electronic and Electrical Components
MIL-STD-220A	Method of Insertion-Loss Measurement
MIL-STD-285	Attenuation Measurement for Enclosures, Electromagnetic Shielding for Electrical Test Purposes, Method of

4.2 Military Specifications

MIL-F-15733E	Filters, Radio Interference

4.3 Commercial Standards

4.3.1. American Society of Civil Engineers (ASCE) Publications

ASCE 7-95 Minimum Design Loads for Buildings and Other Structures

4.3.2. International Conference of Building Officials (ICBO) Publications

1997 ed. Uniform Building Code

4.3.3. National Fire Protection Association (NFPA) Publications

70-1998 National Electrical Code

4.3.4. Underwriters' Laboratories, Inc. Publications

UL 486A Standard for Safety; Wire Connectors and Soldering Lugs for use with Copper Conductors
UL 1283 Standard for Safety; Electromagnetic Interference Filters

4.3.5 National Electrical Manufacturers Association (NEMA)

250-1997 Enclosures for Electrical Equipment (1000 Volts maximum)
SG 5-1995 Power Switchgear Assemblies
WD 1-1983 General Requirements for Wiring Devices
WD 6-1996 Wiring Devices – Dimensional Requirements

5 TECHNICAL REQUIREMENTS

5.1 GENERAL

5.1.1. Work Site

The work site for this contract is located within Room 127/131, Building 65 of NRL. Contractor personnel shall be restricted to the designated work area and shall not be allowed in adjoining rooms without prior approval of the contracting officer's representative. The Government will designate an area for storage of all contractor materials prior to assembly that will provide adequate environmental protection. There is limited available floor space at the installation site in Room 127/131. As a result of the limited space, the storage area may be located in a non-adjacent room. The contractor shall provide the means to stage the material at the storage area to coincide with the assembly in Room 127/131.

The contractor shall maintain a clean work area upon completion of work at the end of each day. The contractor shall be responsible for the removal and disposal of any construction debris at the completion of the installation.

5.1.2 Installation Site and Available Floor Space

The shielded enclosure shall be positioned in the available floor space of Bldg 65 as shown in figure 1. The overhead clearance of the parent building at the location of the shielded enclosure is 10'-6" minimum. The clearance between the shielded enclosure and the parent building wall is approximately 2 feet. The floor of the parent building is not level and the contractor shall provide the method and means to install the shielded enclosure on the existing parent building floor.

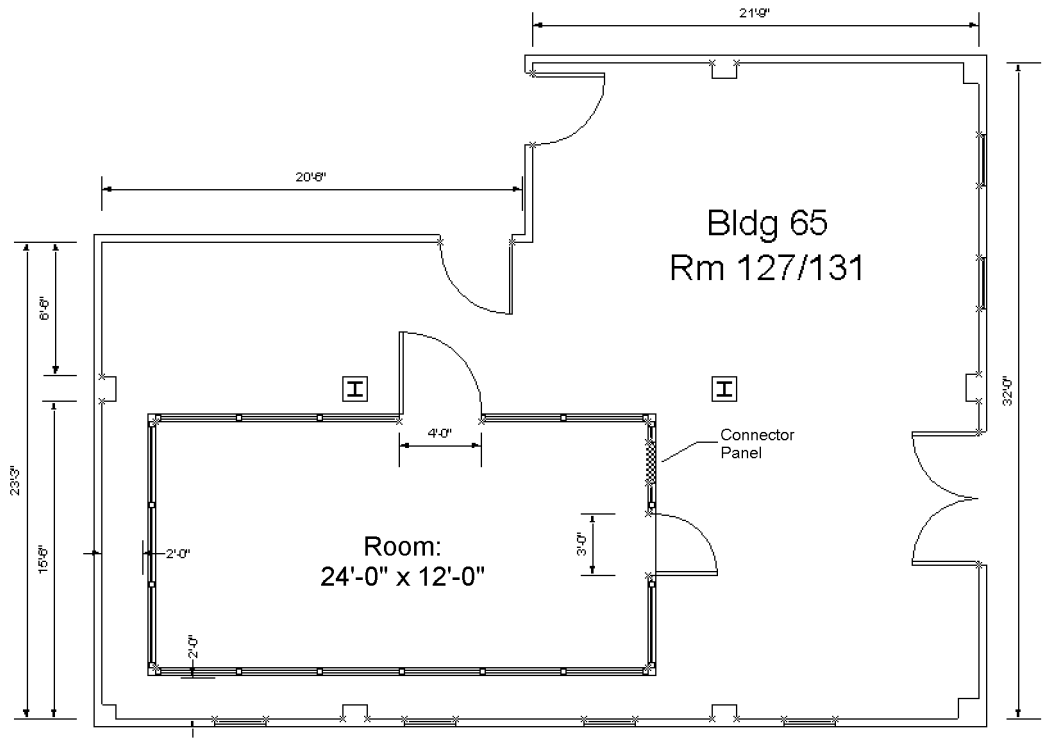

FIGURE 1: Floor Plan (Top View)

5.1.3 Ancillary Equipment Location

The location of all ancillary equipment, both mechanical and electrical, shall be designed in accordance with applicable local, state, and federal building, fire, and safety codes and shall permit easy access for maintenance and repair. All electrical panels, breakers, and disconnect switches shall be located exterior to the shielded enclosure.

5.1.4 Contractor Furnished Equipment (CFE)

The contractor shall be responsible for supervising the quality of workmanship during all phases of shielding enclosure installation.

The contractor shall supply the cranes, compressed air, portable power generator, and all other special facilities to construct, assemble, and install the RF enclosure. Single phase 115 Volt, 20 amp, 1Ø, 60 Hz electrical power will be made available to the contractor at the construction site. Any additional power requirements will be the responsibility of the Contractor.

5.2 SHIELDED ENCLOSURE

5.2.1. General Shielded Enclosure Requirements

The shielded enclosure shall be a modular galvanized steel laminate panel, shielded enclosure. It shall be a freestanding structure with no structural support from the parent building with framing system for floor, wall, and ceilings. The structure shall meet all local, state, and federal building, fire, and safety codes. The shielded enclosure shall provide the required shielding effectiveness equal to or greater than the minimum requirements stated herein. The shielded effectiveness requirements apply to the finished structure, with all electrical and mechanical penetrations installed and operating.

The contractor shall provide protection to the shielded enclosure from any moisture accumulating between the shielded enclosure floor and the floor of the parent building.

The shielded enclosure nominal dimensions shall be 24 feet (l) x 12 feet (w) x 8 feet (h) as shown in fig. 1.

5.2.2 Shielding Effectiveness: Performance Requirement

The minimum attenuation values specified below shall be obtained without exception throughout the entire frequency range and at all test locations. When tested by use of the procedures specified in MIL-STD-285, the completed enclosures and the chamber-to-chamber isolation shall demonstrate minimum shielding (attenuation), in accordance with the following.

Frequency	Type of Field	Shielding Effectiveness (dB)
1 kHz	Magnetic	20
10 kHz	Magnetic	56
100 kHz	Magnetic	90
1 MHz	Magnetic	100
10 kHz	Electric	100
100 kHz	Electric	100
1 MHz	Electric	100
10 MHz	Electric	100
100 MHz	Plane Wave	100
1 GHz	Plane Wave	100
10 GHz	Microwave	100
18 GHz	Microwave	100

5.2.3. Material

All materials, parts, mechanical and electrical assemblies used in the installation of the shielded enclosure shall be new, undamaged and of a quality consistent with the usage of the shielded enclosure.

5.2.4. Shielded Enclosure Penetrations and Attachments

The contractor shall make all the required penetrations in the shielded enclosure. For work performed by subcontractors, the contractor shall either provide the attachment joints and brackets, or provide instructions to the subcontractor involved, in writing, to ensure that attachments do not degrade the shielding effectiveness of the shielded enclosure.

5.2.5. Interior Floors

The finished floor shall be covered with industrial grade vinyl tile having electrostatic charge dissipation properties. ColoRex brand floor tiles manufactured by Forbo, or a suitable equivalent approved by the procuring agency, shall be installed by the contractor in full compliance with the manufacturers specifications, instructions, and application guidelines to achieve static discharge control. The contractor should note that these tiles are available in thicknesses of 2.0 mm and 3.0 mm. Procurement of the specific ESD tile and application materials suited to proper installation in the screen room shall be the responsibility of the contractor.

5.2.6. Loading

The shielded enclosure ceiling shall be capable of supporting loads in accordance with ASCE and UBC requirements.

The shielded enclosure walls shall be capable of supporting loads in accordance with ASCE and UBC requirements.

The shielded enclosure shielding effectiveness shall not be affected by the specified loading of the ceiling, wall, and floor panels.

5.3 ELECTRICAL POWER

5.3.1 General

The contractor shall provide all materials and labor to wire the shielded room for electrical power and lighting in accordance with National Electrical Safety Code. The work includes, but is not limited to furnishing and installing all wiring, conduits, wiring devices, lighting fixtures, switches, receptacles, filters, isolation transformers, distribution panels, breakers, fuses, together with any and all other equipment and accessories indicated, specified or necessary for a complete shielded enclosure installation. This includes all installation wiring inside and outside of the shielded enclosure.

Minimum wire size for light fixtures shall be number 12 AWG. Wiring for light fixtures shall consist of twisted pairs of conductors routed inside conduit. The twists in the conductor pairs shall be in a manner that minimizes magnetic field emission with a least eight turns per foot. The conduit, conduit fittings, junction boxes shall be galvanized rigid metal conduit conforming to NEMA standards. The conduit, all fittings and boxes, must be well grounded to the shielded room wall without penetrating the RF shielding. All conduits shall be parallel to or at right angles to the shielded enclosure walls, floors and ceilings.

Minimum wire size to connect outlet devices shall be number 12 AWG. Wiring for outlets shall consist of twisted pairs of conductors routed inside enclosed steel raceways in a manner that minimizes magnetic field emission with a least eight turns per foot in each conductor pair. The raceways shall be made from press-formed sheet steel conforming to NEMA standards. The raceways, all fittings and devices, must be well grounded to the shielded room wall without penetrating the RF shielding. All raceways shall be run parallel to or at right angles to the shielded enclosure walls, floors and ceilings.

5.3.2 Parent Building Supply Power

The contractor shall make all power connections inside and outside the shielded enclosure up to the disconnect switch of the parent building. The disconnect switch shall be located within 10 feet of the shielded enclosure. The contractor shall notify the COR to have the government electrical trades make the final connection to the disconnect switch.

5.3.3 Breaker Panels

The contractor shall supply the electrical distribution panels, circuit breakers, and all hardware required by the installation drawings to distribute electrical power and lighting power to the shielded enclosure. The materials shall be installed and rated in accordance with the National Electrical Safety Code. The contractor shall identify and label all circuit breakers, switches, receptacles, with adhesive type labels. Labels shall be marked with panel numbers and circuit number.

The location of the power panel shall be exterior to the shielded enclosure. The individual conductors from circuits shall be routed through powerline filters.

5.3.4 Powerline Filter Units (GFE)

The government will supply the contractor will the necessary powerline filters as Government Furnished Equipment.

5.3.5 Powerline Filter Installation

The contractor shall install the powerline filter on the exterior walls of the shielded enclosure. The location shall allow easy access for maintenance and repairs. A separate filter unit shall be used for each type of power, and one (1) individual filter enclosed in the filter unit shall be used for each phase conductor and neutral conductor of the powerline.

5.3.6. Main Chamber Power

The installation shall be in accordance with National Electrical Codes. The following filtered power shall be provided inside the shielded enclosure:

Two (2) each 120/208 volt, 20 amp, 3-phase 4-wire power

The first 120/208-volt service shall be used to supply three (3) 120 volt, 20 amp, 1-phase circuits. Standard NEMA 5-20 configured straight blade duplex receptacles shall be used. The circuits shall be routed along each wall in conduit, or in a raceway, in accordance with National Electrical Codes. The circuits shall be alternately wired to evenly distribute the 1-phase receptacles on the 3-phase service. The NEMA 5-20 duplex receptacles shall be located every 3 feet.

The second 120/208-volt service shall be used to supply power to the lighting system inside the shielded enclosure.

5.3.7. Ground Stud

The grounding system of the shielding enclosure shall be designed to provide for safety of personnel in accordance with the National Electrical Safety Code. The contractor shall provide a threaded ground stud. The ground stud shall penetrate through the shielded enclosure wall and threaded on both ends to allow attachment on either side. The exterior side of the ground stud shall be connected to earth ground and the interior side shall be connected to the copper bus bar.

5.3.8. Copper Bus Bar

A copper bus bar, minimum ½" wide x 3/16" deep, shall be installed on the inside of the shielded enclosure. The copper bus bar shall be routed around each wall, directly above the electrical power raceways. The different sections of the copper bus bar, routed throughout the chamber, shall be permanently bonded together with 10 AWG or larger wire to form an electrically continuous ground system. The bus bar shall be electrically bonded to the ground stud.

5.3.9. Powerline Safety Ground and Neutral Conductor Connections

The powerline safety ground wire shall be routed through the shielded enclosure and connected to the ground stud. The safety ground wire shall be grounded to all conduit, lighting fixtures, and receptacles per the National Electrical Safety Code.

The neutral conductor shall be filtered. The neutral conductor shall be attached to ground per the National Electrical Safety Code.

5.4 LIGHTING

The contractor shall install the lighting system in accordance with National Electrical Safety Code. The contractor shall use incandescent type lighting in the shielded enclosure. The work includes supplying and installing all wiring, conduits, wiring devices, lighting fixtures, switches, receptacles, together with any and all other equipment and accessories indicated, specified or necessary for a complete shielded enclosure lighting system installation. All wiring shall be routed inside conduit.

The lighting system shall consist of a minimum of 18 (each) 180 watt incandescent light fixtures.

5.5 DOORS

Two (2) steel, shielded, manually operated knife-edge doors shall be located per figure 1 and dimensioned as follows.

One (1) 4’ x 7’ clear opening manual knife edge door
One (2) 3’ x 7’ clear opening manual knife edge door

The contractor shall submit evidence of shielding performance of the doors. As a minimum, such evidence shall include a test report showing compliance that meets or exceeds shielding requirements of the shielded enclosure. The installation of the doors shall not degrade the performance of the door. The contractor shall verify that the installed doors meet or exceed the shielding effectiveness requirements specified herein during the final acceptance tests of the shielded enclosure.

5.6 RF CONNECTOR PANEL

One (1) 24” x 24” bulkhead connector panel with removable center panel insert shall be installed on the shielded enclosure and located per figure 1. The bolt hole pattern of the removable center panel insert will be provided to be contractor as Government Furnished Information. The center panel insert installed on the existing screen room in room 321A of building 209 shall be removed by the contractor and installed on the new screen room facility in room 127/131 of building 65. The connector panel insert shall be mounted to the contractor supplied new 24” x 24” bulkhead connector panel.

The connector panels with removable center panel inserts shall be designed and installed in such a manner so as not to degrade the shielding effectiveness requirements of the shielded enclosure.

5.7 WAVEGUIDE AIR VENTS

The contractor shall install eight (8) each 12” x 12” honeycomb waveguide air vents through the ceiling of the shielded enclosure. The contractor shall use waveguide-beyond-cutoff air vents constructed to block EMI that are manufactured using suitable RF shielding (honeycomb) material. The shielding effectiveness of the vents shall meet or exceed the requirements of the shielded enclosure.

Each waveguide air vent input shall have a deflector inside the shielded enclosure mounted in such a way as to deflect the air flow out the sides parallel to the ceiling instead of straight down to the floor.

All waveguide vents shall be designed to ensure proper attachment to the parent building HVAC ductwork. As a minimum, this includes a dielectric collar and a transition adapter to the existing 6” flex ducting.

5.8 FINAL ACCEPTANCE TESTING

Prior to initiating final testing on the shielded enclosure, the contractor shall submit a Quality Assurance Plan describing all tests to be performed on the enclosure to the procurement originator for review and approval. After completion of the RF shielded enclosure, installation of all penetrations and doors, installation and checkout of all electrical and mechanical subsystems, the contractor shall demonstrate compliance with the shielding effectiveness requirements in accordance with the approved test procedures of the Quality Assurance Plan. The warranty period shall commence on the successful completion of this final acceptance test.

6 DOCUMENTATION

All reports, schematics, drawings, manuals, etc., shall be provided to the contracting officer.

6.1 MAINTENANCE AND USERS MANUAL

The contractor shall provide a user and maintenance manual for the shielded enclosure, doors, and all ancillary equipment needing routine maintenance. The manuals shall describe the procedure in detail to maintain the shielded enclosure under the contractor's warranty.

6.2 FINAL ACCEPTANCE TEST REPORT

The contractor shall provide the contracting officer the final acceptance test report, including all the original data, for the completed shielded enclosure. Pass or failure of the requirements shall be clearly stated and the proposed resolution of any unacceptable performance shall be presented.